

coating mixture is applied to obtain a layer thickness of 2 to 8 μm , preferably 3 to 7 μm .

Claim 28 (currently amended) The method as claimed in claim 26, wherein the substrate to be coated is a steel sheet which has previously been zinc-coated and/or chromatized or has been pretreated with a composition that is free of chromate.

Claim 29 (currently amended) The method as claimed in claim 26 25, wherein that said coating and said curing are effected sequentially continuously one after the other in one step and the layer cured by radiation is possibly optionally postcured thermally.

Claim 30 (currently amended) A flexible metal sheet which is electrolytically zinc-coated or hot-dip coated and/or chromatized or pretreated with a composition that is free of chromate and has an organic layer applied thereto, which layer can be obtained by the method as claimed in claim 26.

REMARKS

Reconsideration of this application, as amended, is respectfully requested.

Applicants respectfully traverse the unity of invention objection. No such requirement was required during the International Phase of this application, and it would not be an undue burden on the Examiner to perform a search of all claims. Furthermore, the technical feature is common to all claims as the method claims depend from the claims to the mixture. Furthermore, it is not believed that Kulkarni anticipates or renders obvious the claims, as amended, for reasons discussed hereinbelow.

It is believed that the amendments to the claims and specification overcome all objections thereto. It is also believed that the amendments to the claims overcome all 35 U.S.C. §112, second paragraph rejections of the claims.

Claims 26, 27 and 29 were rejected under 35 U.S.C. §102(e) as allegedly anticipated by Kulkarni. Claims 28 and 30 were rejected as allegedly obvious over Kulkarni in view of Stevens. Applicants respectfully traverse.

Kulkarni discloses a paint composition which may form electroconductive coatings by its

content of polyaniline, but not by an addition of inorganic electroconductive particles. It does not disclose mica particles coated with graphite that are not normally or only very seldom used in paint technology. Among the additives, "iron oxides" are mentioned: There is no indication that this is added because of the electroconductive properties of the black magnetic Fe_3O_4 , but usually only other Fe oxides are added for coloring a paint, e.g., brownish-red with Fe_2O_3 or yellowish-brownish with $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$. These last mentioned compounds may be added in the form of particles or as colloidal or gel-like substances. Of these "iron oxides", only the black magnetic Fe_3O_4 shows significant electroconductivity. The next to last paragraph of column 2 refers to pigments of paints of the state of the art that may be used as corrosion inhibition pigments, but in most cases these refer to silicate or silica pigments; in a few cases aluminum tripolyphosphate pigments are used as corrosion inhibiting pigments. Such corrosion inhibition pigments are typically electrically non-conductive and will reduce the electroconductivity of the coating strongly even if only added 0.5 to 1 % by weight.

The coatings of Kulkarni contain a) a resin on the base of an organic sulfonic acid like a polystyrene sulfonic acid, b) a film-forming organic polymer, e.g., based on acrylics, polyesters, epoxies, urethanes, etc., and optionally an intrinsically electroconductive organic polymer like polyaniline. Although it is indicated that the polymer b) may be cured by heat, UV etc., it is not clear if a curing by irradiation of UV light or heat is necessary and which type of curing is used in the examples. Additionally, a non-ionic self cross-linking acrylic emulsion is added in Example 3, and the composition of example 4 contains an internal amine crosslinker. Therefore, the mention of UV curing is vague. There is no hint to add a photoinitiator and to select polymers that may be radically cured as such polymers have to be selected to be polymerized in such a way.

Further, there is no mention of a coating thickness except that it is at least 0.1 mils. Even in the examples, there is no coating thickness and no coating weight described so that a correlation of the corrosion inhibiting effect of the coating cannot be evaluated, as a thick coating will always have a significant better corrosion resistance than a thin one. Typically, one coating layer of a paint will have a thickness in the range of 20 to 50 microns and even up to now there are relatively few applications with a thickness layer below 10 microns.

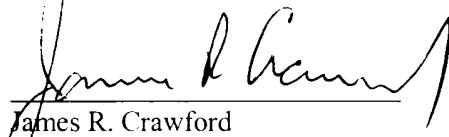
Stevens teaches a rubber article with a reinforcement structure of a metallic filament which may be a filament of steel wires coated with a zinc-containing layer. The wire is then coated with a polymeric material containing polyaniline. Stevens does not overcome the deficiencies of Kulkarni.

In view of the foregoing, allowance is respectfully requested.

If any fees are due to enter this paper or to maintain pendency of this application, authorization is given to charge deposit amount no. 50-0624.

Respectfully submitted,

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Coating Method and Coating Mixture

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a method of applying a weldable anticorrosive coating to a metallic substrate, in particular a body sheet for the automotive industry, as well as a coating mixture for performing this method.

Weldable protective coatings as mentioned above on the basis of inorganic pigment particles and organic polymers are known and described for instance in DE-C-34 12 234.

EP-B-298 409 describes such coatings for steel sheet, which coatings have a layer of silicic acid and a cured organic matrix, which was obtained from an epoxy resin and a polyvalent isocyanate by thermal cross-linkage.

EP-C-344 129 describes similar coatings, which are obtained by curing epoxy resins by means of amines, melamines, phenol resins and the like.

EP-A-761 320 describes coated steel sheets, which carry an organic protective layer which was produced from an aqueous solution by electrolytic polymerization of ionogenic polymerizable organic compounds.

EP-A-659 855 describes an aqueous coating mixture, from which curable antirust coatings can be deposited

All these known coating mixtures contain organic or aqueous solvents, which must be evaporated upon application. To achieve a durable resistance to chemicals and weathering influences as well as a sufficient rust protection, these coatings must be cured by heating. This has the disadvantage of a higher consumption of energy and the risk of the emission of volatile components to the environment by evaporation. Moreover, chemically cross-linked polymer coatings frequently tend to become brittle.

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DETAILED DESCRIPTION

The polymeric binder is solid and may be saturated itself. Preferably, the polymeric binder contains unsaturated polymerizable groups which in the case of the radiation-initiated polymerization of the polymerizable compound can react with the same and form an insoluble network.

Suitable binders include condensation resins, epoxy resins, poly(meth)acrylates, polyurethanes, polyesters, polyethers and other similar polymers or polymers derived therefrom. Preferred binders include epoxidized novolaks, bisphenol epichlorohydrin condensation products and esterification products of the above-mentioned resins or polymers with acrylic or methacrylic acid. When epoxidized novolaks are used, the same may be made on the basis of phenol, substituted phenols (for instance cresol) or also polyvalent, possibly substituted phenols or mixtures of the aforementioned phenols.

The low-molecular monomeric compound contains at least one polymerizable ethylenically unsaturated group. To achieve a rather good cross-linkage and thus insolubility and resistance of the layer to solvents, chemicals and weathering influences, at least part of the polymerizable compounds should contain at least two polymerizable groups. Preferably, the polymerizable compound is an ester of an α,β -unsaturated carboxylic acid with a di- or polyvalent, possibly also oligomeric alcohol. Esters of acrylic or methacrylic acid are preferred particularly. Apart from ester groups, the polymerizable compounds may also contain other functional groups, in particular ether, amide or urethane groups. Examples for suitable polymerizable compounds include dipropylene and tripropylene glycol di(meth)acrylate, 2-acetoacetoxy ethyl methacrylate, hexanediol diacrylate, hydroxypropyl methacrylate, hydroxyethyl methacrylate, trimethylolpropane triacrylate.

As compounds forming radicals when irradiated, in particular photoinitiators, especially those can be used, which have a strong absorption in the spectral range of the radiation used, in particular of the near ultraviolet or short-wave visible light, i.e. with a wavelength approximately in the range from 180 to 700 nm. There can be used above all aromatic carbonyl compounds and the derivatives thereof, such as quinones, ketones and the ketals thereof, for example benzildimethylketal, benzoin, substituted benzoins and benzoin ethers, α -amino ketones; furthermore polynuclear heterocyclic compounds such as acridines, phenazines and the sub-

Example 1

A mixture of

20 pbw of a novolak epoxy resin esterified with acrylic acid (Viaktin® VTE 6152, 65 % in tripropylene glycol diacrylate, Vianova Resins),

15 pbw of an aliphatic urethane acrylate (Syntholux® DRB 227, 65 % in hydroxypropyl methacrylate, Synthopol-Chemie),

26.7 pbw acetoacetoxy ethyl methacrylate (Lonzamon® AAEMA, Lonza AG, Basel),

8 pbw magnetizable iron oxide (Magnetschwarz® S 0045, BASF AG),

12 pbw iron phosphide (Ferrophos® HRS 2132, Occidental Chemical Corp., Niagara, USA),

3 pbw aluminum triphosphate (K-White 105, Teikoku Kako Co., Osaka),

6 pbw benzildimethylketal (Irgacure® 651, Ciba-Geigy AG),

1 pbw Irgacure® 1850 (Ciba-Geigy), mixture of 50 % 1-hydroxy-cyclohexyl-phenyl ketone and 50 % bis(2,6-dimethoxybenzoyl-2,4,4-trimethylpentyl-phosphine oxide),

8 pbw 1-hydroxy-cyclohexyl-phenyl ketone (Irgacure® 184), and

0.3 pbw substituted phosphine oxide (Irgacure® 819)

AMENDED CLAIMS

[received by the International Office on 31 October 2000 (31/10/00);
original claims 1-13 replaced by new claims 1-15; (3 pages)]

IT IS CLAIMED:

1. A coating mixture with anticorrosive properties, comprising a polymeric organic binder, a low-molecular liquid compound to be subjected to free-radical polymerization, a compound forming radicals under the influence of actinic radiation, and a conductive inorganic pigment, from the group including oxides, phosphates and phosphides of iron and aluminum and graphite-mica pigments.
2. The mixture as claimed in claim 1, characterized in that the conductive inorganic pigment is magnetizable iron oxide or iron phosphide or a combination of these two pigments.
3. The mixture as claimed in claim 1 or 2, characterized in that the binder is present in an amount of 15 to 60, preferably 20 to 50, in particular 20 to 40 % by weight,
the polymerizable compound is present in an amount of 24 to 60, preferably 20 to 55, in particular 25 to 50 % by weight,
the pigment is present in an amount of 10 to 40, preferably 10 to 35, in particular 12 to 35 % by weight,
and the photoinitiator is present in an amount of 5 to 30, preferably 8 to 25, in particular 8 to 20 % by weight, as well as further additives are present in an amount of 0.1 to 5, preferably 0.3 to 4, particularly preferably 0.4 to 3 % by weight.
4. The mixture as claimed in any of claims 1 to 3, characterized in that it is free of organic solvents and water.
5. The mixture as claimed in any of claims 1 to 4, characterized in that the binder itself still contains polymerizable groups.
6. The mixture as claimed in any of claims 1 to 5, characterized in that the binder is selected from the group including condensation resins, epoxy res-